WHAT IS CLAIMED IS:

1. A system for determining the position, orientation and system gain factor of a probe comprising:

a plurality of magnetic field sources;

at least one magnetic field sensor, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a probe whose gain, position, and orientation affects said unique measured magnetic field values; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said probe and a plurality of location factors indicative of the position and orientation of said probe;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

2. The system for determining the position, orientation and system gain factor of claim 1 wherein said iterative process is configured to determine a function of the differences between said measured magnetic field values and a plurality of predicted magnetic field values.

3. The system for determining the position, orientation and system gain factor of claim 2 wherein said processor includes a calculated location process for calculating said predicted magnetic field values, wherein said calculated location process guesses an initial gain, position, and orientation for said probe, and calculates said predicted magnetic field values based on a physical model and said initial gain, position, and orientation.

4. The system for determining the position, orientation and system gain factor of claim 3 wherein said initial position and orientation is a predetermined fixed point.

5. The system for determining the position, orientation and system gain factor of claim 3 wherein said initial position and orientation is a randomly selected fixed point.

6. The system for determining the position, orientation and system gain factor of claim 3 wherein said processor includes an optimization function for determining an extremum indicative of said differences between said measured magnetic field values and said predicted magnetic field values.

7. The system for determining the position, orientation and system gain factor of claim 6 wherein said optimization function is a least squares sum function.

8. The system for determining the position, orientation and system gain factor of claim 6 wherein said processor includes a repositioning process for adjusting said initial gain, position, and orientation of said probe in response to said extremum being in a predefined range of unacceptable values, which is indicative of an unacceptable level of difference between said measured magnetic field values and said plurality of predicted magnetic field values.

9. The system for determining the position, orientation and system gain factor of claim 1 wherein said location factors include spatial coordinates.

10. The system for determining the position, orientation and system gain factor of claim 1 wherein said location factors include spherical coordinates.

11. The system for determining the position, orientation and system gain factor of claim 1 wherein said location factors include rotational coordinates.

12. A system for determining the position, orientation and system gain factor of a probe comprising:

a plurality of magnetic field sensors;

at least one magnetic field source, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a probe whose gain, position, and orientation affects said unique measured magnetic field values; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said probe and a plurality of location factors indicative of the position and orientation of said probe;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

13. The system for determining the position, orientation and system gain factor of claim 12 wherein said iterative process is configured to determine a function of the differences between said measured magnetic field values and a plurality of predicted magnetic field values.

14. The system for determining the position, orientation and system gain factor of claim 13 wherein said processor includes a calculated location process for calculating said predicted magnetic field values, wherein said calculated location process guesses an initial gain, position, and orientation for said probe, and calculates said predicted magnetic field values based on a physical model and said initial gain, position, and orientation.

15. The system for determining the position, orientation and system gain factor of claim 14 wherein said initial position and orientation is a predetermined fixed point.

16. The system for determining the position, orientation and system gain factor of claim 14 wherein said initial position and orientation is a randomly selected fixed point.

17. The system for determining the position, orientation and system gain factor of claim 14 wherein said processor includes an optimization function for determining an extremum indicative of said differences between said measured magnetic field values and said predicted magnetic field values.

18. The system for determining the position, orientation and system gain factor of claim 17 wherein said optimization function is a least squares sum function.

19. The system for determining the position, orientation and system gain factor of claim 17 wherein said processor includes a repositioning process for adjusting said initial gain, position, and orientation of said probe in response to said extremum being in a predefined range of unacceptable values, which is indicative of an unacceptable level of difference between said measured magnetic field values and said plurality of predicted magnetic field values.

20. The system for determining the position, orientation and system gain factor of claim 12 wherein said location factors include spatial coordinates.

21. The system for determining the position, orientation and system gain factor of claim 12 wherein said location factors include spherical coordinates.

22. The system for determining the position, orientation and system gain factor of claim 12 wherein said location factors include rotational coordinates.

23. A system for determining the position, orientation and system gain factor of a probe comprising:

one of a plurality of magnetic field sensors and a plurality of magnetic field sources;

at least one of the other of the magnetic field sensors and magnetic field sources, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a probe whose gain, position, and orientation affects said unique measured magnetic field values; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said probe and a plurality of location factors indicative of the position and orientation of said probe;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

24. The system for determining the position, orientation and system gain factor of claim 23 wherein said iterative process is configured to determine a function of the differences between said measured magnetic field values and a plurality of predicted magnetic field values.

25. The system for determining the position, orientation and system gain factor of claim 24 wherein said processor includes a calculated location process for calculating said predicted magnetic field values, wherein said calculated location process guesses an initial gain, position, and orientation for said probe, and calculates said predicted magnetic field values based on a physical model and said initial gain, position, and orientation.

26. The system for determining the position, orientation and system gain factor of claim 25 wherein said initial position and orientation is a predetermined fixed point.

27. The system for determining the position, orientation and system gain factor of claim 25 wherein said initial position and orientation is a randomly selected fixed point.

28. The system for determining the position, orientation and system gain factor of claim 25 wherein said processor includes an optimization function for determining an extremum indicative of said differences between said measured magnetic field values and said predicted magnetic field values.

29. The system for determining the position, orientation and system gain factor of claim 28 wherein said optimization function is a least squares sum function.

30. The system for determining the position, orientation and system gain factor of claim 28 wherein said processor includes a repositioning process for adjusting said initial gain, position, and orientation of said probe in response to said extremum being in a predefined range of unacceptable values, which is indicative of an unacceptable level of difference between said measured magnetic field values and said plurality of predicted magnetic field values.

31. The system for determining the position, orientation and system gain factor of claim 23 wherein said location factors include spatial coordinates.

32. The system for determining the position, orientation and system gain factor of claim 23 wherein said location factors include spherical coordinates.

33. The system for determining the position, orientation and system gain factor of claim 23 wherein said location factors include rotational coordinates.

34. A system for determining the position, orientation and system gain factor of a three-dimensional object comprising:

one of a plurality of magnetic field sensors and a plurality of magnetic field sources;

at least one of the other of the magnetic field sensors and magnetic field sources, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a three-dimensional object whose gain, position, and orientation affects said unique measured magnetic field values; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said three-dimensional object and a plurality of location factors indicative of the position and orientation of said three-dimensional object;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

35. A method for determining the position, orientation and system gain factor of a three-dimensional object comprising:

positioning a plurality of magnetic field sources proximate the three-dimensional object;

positioning at least one magnetic field sensor in a fixed spatial relationship with the three-dimensional object, wherein a combination of a magnetic field sensor

and a magnetic field source generates a unique measured magnetic field value, and the gain, position, and orientation of the three-dimensional object affects the unique measured magnetic field values; and

determining a system gain factor indicative of the gain of the three-dimensional object and a plurality of location factors indicative of the position and orientation of the three-dimensional probe, wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

36. The method for determining the position, orientation and system gain factor of claim 35 wherein said determining a system gain factor and a plurality of location factors includes determining a function of the differences between the measured magnetic field values and a plurality of predicted magnetic field values.

37. The method for determining the position, orientation and system gain factor of claim 36 wherein said determining a system gain factor and a plurality of location factors includes guessing an initial gain, position, and orientation for the three-dimensional object and calculating the predicted magnetic field values based on a physical model and the initial gain, position, and orientation.

38. The method for determining the position, orientation and system gain factor of claim 37 wherein said determining a system gain factor and a plurality of location factors includes determining an extremum indicative of the differences between the measured magnetic field values and the predicted magnetic field values.

39. The method for determining the position, orientation and system gain factor of claim 38 wherein said determining a system gain factor and a plurality of location factors includes adjusting the initial gain, position, and orientation of the three-dimensional object in response to the extremum being in a predefined range of unacceptable values, which is indicative of an unacceptable level of difference between the measured magnetic field values and the plurality of predicted magnetic field values.

40. A method for determining the position, orientation and system gain factor of a three-dimensional object comprising:

positioning a plurality of magnetic field sensors proximate the three-dimensional object;

positioning at least one magnetic field source in a fixed spatial relationship with the three-dimensional object, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value, and the gain, position, and orientation of the three-dimensional object affects the unique measured magnetic field values; and

determining a system gain factor indicative of the gain of the three-dimensional object and a plurality of location factors indicative of the position and orientation of the three-dimensional probe, wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

41. A system for determining the position, orientation and system gain factor of a hollow tube comprising:

a plurality of magnetic field sources;

at least one magnetic field sensor, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a hollow tube whose gain, position, and orientation affects said unique measured magnetic field values, wherein said at least one magnetic field sensor is positioned within said tube; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said hollow tube and a plurality of location factors indicative of the position and orientation of said hollow tube;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.

42. A system for determining the position, orientation and system gain factor of a hollow tube comprising:

a plurality of magnetic field sensors;

at least one magnetic field source, wherein a combination of a magnetic field sensor and a magnetic field source generates a unique measured magnetic field value,

a hollow tube whose gain, position, and orientation affects said unique measured magnetic field values, wherein said at least one magnetic field source is positioned within said tube; and

a processor, configured to receive and iteratively process said unique measured magnetic field values, for determining a system gain factor indicative of the gain of said hollow tube and a plurality of location factors indicative of the position and orientation of said hollow tube;

wherein the number of unique measured magnetic field values generated is at least equal to the sum of the number of gain and location factors calculated.